506-CD-002-001

EOSDIS Core System Project

Configuration Audits for Flight Operations Segment (FOS) Release A for the ECS Project

December 1996

Hughes Information Technology Systems
Upper Marlboro, Maryland

Configuration Audits for Flight Operations Segment (FOS) Release A for the ECS Project

December 1996

Prepared Under Contract NAS5-60000
CDRL Item 081

SUBMITTED BY

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Upper Marlboro, Maryland

506-CD-002-001

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Preface

This document is a formal contract deliverable with an approval code 3. This document is delivered to NASA for information only, but is subject to approval as meeting contractual requirements. Once this document is approved, Contractor approved changes are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by document change notice (DCN) or by complete revision.

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Abstract

This report is a documented account of configuration audits conducted on the Flight Operations Segment Release A during the period November 6, 1996 through December 1, 1996.

The report includes:

- Analysis of the requirements for configuration audits;
- Conduct of configuration audits of FOS Release A;
- Results of the Physical Configuration Audits (PCAs) and the Functional Configuration Audit (FCA);
- Lessons learned from these audits.

Keywords: Configuration audits, Physical Configuration Audit, PCA, Functional Configuration Audit, FCA, Certification, Product Baseline, PBL, Acceptance Test, Flight Operations Segment, FOS, Material Inspection and Receiving Report, MIRR, and DD Form 250.

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1. Introduction

1.1 Identification

This Audit Reports Document, Contract Data Requirements List (CDRL) Item 081, whose requirements are specified in Data Item Description (DID) 506/PA3, is a required deliverable under the Earth Observing System (EOS) Data and Informaton System (EOSDIS) Core System (ECS) Contract (NAS 5-60000).

1.2 Scope

This document describes the Audit Report results from the accomplishment of the FCA and PCA FOS Release A from September 18, 1996 to December 2, 1996, the date of submission of the Material Inspection and Receiving Report (DD Form 250) to the government is the period covered by this report for the ECS Project.

1.3 Purpose

This document provides the account of configuration audits conducted on the FOS Release A configuration during the reporting period.

1.4 Status and Schedule

This is a final report and is submitted in accordance with the requirement that it be released NLT 30 days after Release Readiness Review, which was held on November 27, 1996.

1.5 Organization

This report is organized as follows:

Section 1 identifies the source requirement for this report, defines the scope, establishes the purpose, and provides the schedule for delivery.

Section 2 list parent, applicable, and guidance documents for this report.

Section 3 sets forth the requirements for configuration audits, establishing the Product Baseline (PBL) for a release, and preparing the Material Inspection and Release Report (DD Form 250).

Section 4 describes the conduct of the audits, to include a schematic describing the process and the components of the PBL. Also included is the schematic provided to define the location of audit equipment.

Section 5 presents results of the audits. This section also includes a section devoted to other (non-NCR) observations.

Section 6 summarizes lessons learned from the audits.

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2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content are derived.

420-02-02 (Rev A)	Goddard Space Flight Center, Earth Observing System (EOS) Configuration Management Plan
420-05-03	Goddard Space Flight Center, Earth Observing System (EOS) Performance Assurance Requirements for the EOSDIS Core System (ECS)
423-41-01	Goddard Space Flight Center, EOSDIS Core System (ECS) Statement of Work
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data Information System (EOSDIS) Core System (ECS)
423-41-03	Goddard Space Flight Center, EOSDIS Core System (ECS) Contract Data Requirements Document

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, this document shall take precedence.

101-CD-001-004	Project Management Plan for the EOSDIS Core System, Revision 1, DCN No. 01
102-CD-001-004	Development Configuration Plan for the ECS Project
102-CD-002-001	Maintenance and Operations Configuration Management Plan for the ECS Project
104-CD-001-004	Data Management Plan for the ECS Project, Revision 1
194-201-SE1-001	Systems Engineering Plan for the ECS Project
194-207-SE1-001	System Design Specification for the ECS Project
210-CD-001-003	System Engineering Plan for the ECS Project
308-CD-001-006	Software Development Plan for the ECS Project

409-CD-001-004	ECS Overall System Acceptance Test Plan for Release A
194-415-VE1-002	Acceptance Testing Management Plan for the ECS Project
501-CD-001-004	Performance Assurance Implementation Plan for the ECS Project
194-602-OP1-001	Property Management Plan for the ECS Project
620-WP-001-001	Turnover Plan for the ECS Project

2.3 Information Documents

The following documents, although not directly applicable, amplify or clarify the information presented in this document, but are not binding on the content herein.

MIL-STD-948	Department of Defense, Military Standard for Software Development and Documentation
MIL-STD-973	Department of Defense, Military Standard for Configuration Management

3. Requirements for Configuration Audits

3.1 Configuration Audits

Requirements for configuration audits, and their accompanying documentation requirements, are found in numerous parent and applicable documents. The "driving" requirements for these audits are summarized in paragraph 3.1.1, which follows.

To conduct a PCA the project must develop a PBL. The requirements for this are summarized in paragraph 3.2 along with the FCA requirements for integrated assessment of test status. Finally the requirements for preparing a DD Form 250 may be found at paragraph 3.3.

3.1.1 Earth Observation System (EOS) Configuration Management Plan

Section 6 - Configuration Verification states the purpose of configuration audits "to prove that the actual configuration of hardware CIs conforms to the intended configuration (the as-built configuration matches the as-designed configuration). Configuration audits validate the accomplishment of development requirements (Functional Configuration Audit) and achievement of a production configuration through comparison with the CIs technical documentation (Physical Configuration Audit).

Paragraph 6.2 requires "EOS Project CMOs shall be responsible for conducting periodic configuration audits at the Project and contractor levels. This audit process ensures that CM procedures are being adhered to and properly implemented . . ." This document stipulates the timing of these audits by requiring that the "CMOs shall participate in a combined functional and configuration audit performed on each EOS CI at the completion of its integration and testing phase prior to delivery to NASA."

3.1.2 Draft ESDIS Configuration Management Plan

Paragraph 6.1 states that "Configuration audits validate the achievement of development requirements and the identification of product configuration by comparing the CI with its technical documentation. Configuration audits are conducted to ensure that the actual CIs conform to the intended configuration (the "as built" configuration matches the "as designed" configuration)."

Paragraph 6.3 and 6.4 establish requirement for Functional Configuration Audits (FCA) and Physical Configuration Audits (PCA) of ECS and require that the contractor use MIL-STD-973 as a guideline.

Paragraph 8.6 sets completion dates of the audits as preceding the Release Readiness Review (RRR).

3.1.3 Developmental Configuration Management Plan for the ECS Project

This plan requires that FCAs/PCAs validate:

- The as-built configuration compares directly with the documented configuration identification represented by the detailed CI specifications.
- Test results verify that each ECS product meets its specified performance requirements to the extent determinable by testing.
- The as-built configuration being shipped compares with the final tested configuration. Any differences between the audited configuration and the final tested configuration are documented.
- When not verified by test, the compatibility of ECS products with interfacing products or equipment is established by comparison of documentation with the interface specifications which apply.
- COTS products are included in FCAs and PCAs as integral parts of the ECS baseline.

3.1.4 Turnover Plan for the ECS Project

This plan defines goals of each audit and established principle of establishing the Product Baseline and preparing DD 250 for government acceptance, as result of audits. It stipulated that configuration audits would be conducted by ECS Project team with Government participation.

3.1.5 MIL-STD-973

This standard, which serves only as a guideline for FOS configuration audits, specifies FCA and PCA requirements and introduces the certification process and development of the DD Form 250.

This standard defines an FCA as the "formal examination of functional characteristics of CI prior to acceptance to assure that the item has achieved the requirements specified in its functional and allocated configuration documentation. It is conducted on each CI for which a separate specification has been baselined and for the overall system as required by the contract." MIL STD 973 states that the "PCA for a CI shall not be started unless the FCA for the CI has already been accomplished, or is being accomplished concurrent with the PCA." For FCAs the contractor is required to identify items to be audited and to provide the current list of deviations and waivers, status of test program; and a requirements matrix that cross references test plans, procedures, and deficiencies.

PCA is defined as the formal examination of the "as built" configuration of a CI against its design documentation. Contractor requirements for hardware include detailed analysis of engineering drawings, specifications, technical data, and tests conducted. Contractor requirements for software: detailed audit of design documentation, listings, and operation and support documentation. For both HWCI and CSCI the audit assures that the "as built" or "as coded" configuration is reflected in the documentation reviewed. For each PCA the contractor is

expected to provide change listings, parts lists, a complete shortage list, a Version Description Documents for CSCIs, and the results of FCA.

MIL STD 973 also requires Certification Sheets for signature at completion of all audit phases and the development of a Material Inspection and Review Report (DD 250).

3.2 Requirements for Establishing the Product Baseline

3.2.1 Earth Observation System (EOS) Configuration Management Plan

PBL shall document the "as built" configuration of the CI[1]. It shall be validated by the functional and physical configuration audits performed on the CI. This baseline includes subsystem specifications, test reports, approved drawings, associated lists, and approved change documentation. The PBL shall be reviewed and approved as part of the Pre-Ship review by the EOS Project personnel and the Flight Assurance Manager.

3.2.2 System Engineering Plan for the ECS Project:

This plan states that the PBL is described at the CSR. Once the release is fabricated into that baseline, and tested, a released baseline is established containing corrections made for errors discovered during test execution.

3.2.3 Development Configuration Plan for the ECS Project.

3.3.3 Development Configuration Plan for the ECS:

The baseline which establishes the "as-built" configuration for system-level integration and testing and independent acceptance testing. This baseline is validated by functional and physical configuration audits, and reviewed and approved by GSFC as part of RRR.

3.2.4 ESDIS Configuration Management Plan[2]

This plan states that the ECS PBL is established at CSR, after successful completion of testing at the ECS Development Facility, and represents the ECS release configuration that is authorized for delivery to ESDIS Project designated sites for acceptance testing. This baseline is approved by the ESDIS Project and placed under the control of the ECS Review Board.

3.3 Requirement for Preparing DD 250 (MIRR)

3.3.1 NAS5-60000 Earth Observing System Contract:

Section B.1 DELIVERABLE REQUIREMENT (GSFC 52.210-90) (OCT 1988) states that "The Contractor shall perform and/or deliver . . . " as Item 1.1 "FOS Release A", as specified in the Statement of Work paragraph 2.5.1.2.

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1 FOS, and other ECS-developed systems, will be validated at the subsystem level.

2 This plan, Document Nr. 5051021, received in June 1995 has not been issued.

Section E.19 MATERIAL INSPECTION AND RECEIVING REPORT (18-52.246-72) (OCT 1988) states that "At the time of each delivery under this contract , the Contractor shall furnish to the Government a Material Inspection and Receiving Report (DD Form 250 series) prepared in an original copy and sufficient other copies to accomplish . . . distribution."[3]

Section F.2 SHIPPING INSTRUCTIONS requires that audits be conducted prior to Government acceptance

3.3.2 DD FORM 250

This form is prepared in accordance with instructions contained in Defense Federal Acquisition Regulations (DFARS), Appendix F-401.

[3] The following section (E.11) exempts specific deliverable items (e.g., Progress Reviews) from the DD 250 requirement. By exception the following deliveries require submission of the DD 250: SDPS and CSMS Release A, **FOS Release A**, Interim Release 1, SDPS and CSMS Release B, FOS Release B, Release C, Release D, and Toolkit deliveries. It should be noted that this provision was not known to the Audit Team until November 27, 1996. However, once recognized, activities were organized and the report delivered to the Government on the scheduled date.

4. Conduct of Audits of FOS Release A

4.1 Audit Objectives:

a. Examine "as built" ECS configuration to assure it conforms to Release A design documentation. (Physical Configuration Audit)

b. Evaluate functional characteristics of the ECS system to assure it meets design requirements specified in contract[4]. (Functional Configuration Audit)

c. Certify that hardware and software configuration audited is configured in accordance with Product (Release A) Baseline.

d. Prepare DD 250 (or NASA equivalent) for government signature accepting Product (Release A) Baseline at Release Readiness Review. (If required)

4.2 Scope of Audits

To implement these objectives a phased approach was proposed. Initially the audit team assessed documentation requirements and determined the minimum set that would be required and the timelines within which Acceptance Testing would be conducted. After discussions with FOS the PBL was defined as being composed of the software Version Description Document (VDD) and a technical paper describing the hardware, which was referred to as the "White Paper". Dates for acceptance testing were described as falling within the period between Consent to Ship Review (CSR), held on November 7, 1996 and the Release Readiness Review (RRR), held on November 27, 1996.

Guidelines (MIL STD 973) suggested that the FCA precede the PCA; however, it was apparent from the first that acceptance testing would continue until RRR. As a result the PCA preceded the FCA.

PCA was held at the EOS Operations Center (EOC) on November 14 and resumed on November 22, 1996. Prior to this audit a "kickoff" meeting was held at the Hughes Information Technology Company (HITC) office on November 6, 1996 at which all team members met and stated their audit requirements.

FCA was held at the HITC offices in Landover, Maryland on November 25, 1996. It was preceded by a "kickoff" meeting on November 21, 1996.

Audit results were compiled and briefed at the RRR on November 27, 1996.

The Material Inspection and Receiving Report for FOS Release A was prepared and delivered to the Government on December 2, 1996.

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[4] RbR, IRDs and Level 3's. (Note: FOS tested to Level 4's.)

This process is shown schematically in the following figure.

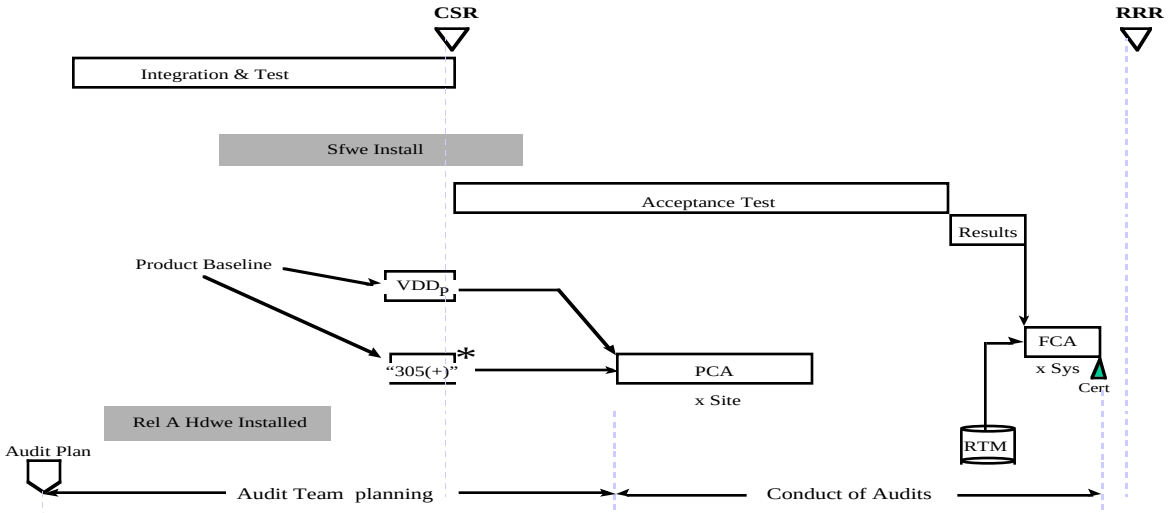

Figure 4-1. Scope of Audits

4.3 PCA

The PCA examined the "as built" ECS configuration, as "seen" at the EOC, to assure it conformed to Release A design documentation, as described by the Product Baseline (PBL).

4.3.1 Product Baseline

As defined for this review the PBL consisted of:

4.3.1.1 814-RD-007-002, Version Description Document (VDD).

This document, which described the software delivery, included a Product Inventory (Section 4) that contained the product description, product inventory (to include document description, description of mag tape used to archive the delivered baseline, utility and support software included on custom listing, COTS software inventory (referred to as Table 4-1), shareware inventory (referred to as Table 4-2), and the FOS custom software files (located in para 4.2.1). The VDD also included Non-Conformance Reports[5] (NCR) separated into three categories: Known Problems, Closed NCRs, and Open NCRs.

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5 NCRs were included for the period up to its publication date.

VDD included appendices for Build Instructions, Installation Procedures, Special Operating Procedures, and User Feedback Procedures.

Contents of the VDD were set forth in ECS Project Instruction CM-1-020. Information for developing the VDD was provided to the Configuration Management Office (CMO) by FOS project personnel. The VDD was approved: 11/12/96 by ECS CCB.

4.3.1.2 320-WP-001-002, White Paper ("Technical Baseline").

This document contained the COTS System Level Diagram (Figure 2-1) and COTS Hardware Tables[6] (Appendix A). These table contained only equipment that was part of FOS Release A. Tables consisted of an Overview (Table A-1) and the following component tables (Table A-2 through 21): CSS Server, Internetworking Equipment, four printers, RAID File Server, four FOT User Stations, Real Time Server, Data Server, two Consoles, Time Gateways (2 ea.), MSS Workstation, MSS Server, and Multicast Server.

Contents of the White Paper were established by the FOS Deputy Manager. Information for the White Paper was obtained by FOS personnel from the Vendor Costing And Tracking System (VCATS) database. This documentation was provided in spreadsheet form containing both software and hardware information[7]. The White Paper was approved on 11/11/96 by FOS CCB.

4.3.2 Other documentation.

While not part of the PCA draft floor plans were obtained from the ECS Maintenance and Operations (M&O) office and used to identify equipment in the EOC. These plans, when "pasted" consisted of a schematic of the equipment room (ER), a schematic of the console room (where the majority of acceptance testing took place), and a "cross walk" between the three numbering systems used to account for the inventory of equipment: the FOS numbering system, the M&O floor plan numbering system, and the White Paper table numbering system[8].

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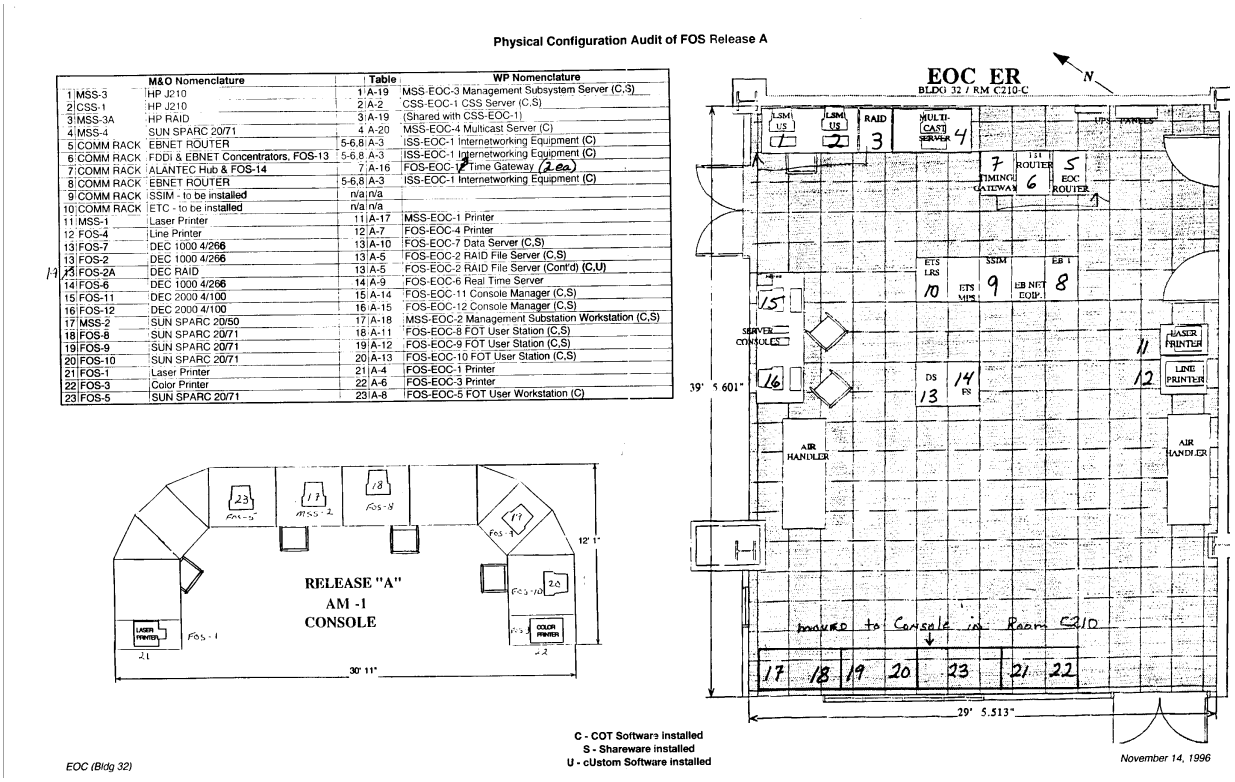
6 Incorrectly referred to as Hardware and Software Tables in the document. Only hardware information was included in the final version of this document.

7 The software information was removed from the spreadsheet and provide to CMO for incorporation into the VDD.

8 This last portion of the floor plans was added by the audit team for its use.

The combined plan, reduced to fit, is shown on the figure.



	M&O Nomenclature		Table	WP Nomenclature
1	MSS-3	HP J210	1 A-19	MSS-EOC-3 Management Subsystem Server (C,S)
2	CSS-1	HP J210	2 A-2	CSS-EOC-1 CSS Server (C,S)
3	MSS-3A	HP RAID	3 A-19	(Shared with CSS-EOC-1)
4	MSS-4	SUN SPARC 20/71	4 A-20	MSS-EOC-4 Multicast Server (C)
5	COMM RACK	EBNET ROUTER	5-6,8 A-3	ISS-EOC-1 Internetworking Equipment (C)
6	COMM RACK	FDDI & EBNET Concentrators, FOS-13	5-6,8 A-3	ISS-EOC-1 Internetworking Equipment (C)
7	COMM RACK	ALANTEC Hub & FOS-14	7 A-16	FOS-EOC-1 Time Gateway (2 ea)
8	COMM RACK	EBNET ROUTER	5-6,8 A-3	ISS-EOC-1 Internetworking Equipment (C)
9	COMM RACK	SSIM - to be installed	n/a n/a	
10	COMM RACK	ETC - to be installed	n/a n/a	
11	MSS-1	Laser Printer	11 A-17	MSS-EOC-1 Printer
12	FOS-4	Line Printer	12 A-7	FOS-EOC-4 Printer
13	FOS-7	DEC 1000 4/266	13 A-10	FOS-EOC-7 Data Server (C,S)
13	FOS-2	DEC 1000 4/266	13 A-5	FOS-EOC-2 RAID File Server (C,S)
13	FOS-2A	DEC RAID	13 A-5	FOS-EOC-2 RAID File Server (Cont'd) (C,U)
14	FOS-6	DEC 1000 4/266	14 A-9	FOS-EOC-6 Real Time Server
15	FOS-11	DEC 2000 4/100	15 A-14	FOS-EOC-11 Console Manager (C,S)
16	FOS-12	DEC 2000 4/100	16 A-15	FOS-EOC-12 Console Manager (C,S)
17	MSS-2	SUN SPARC 20/50	17 A-18	MSS-EOC-2 Management Substation Workstation (C,S)
18	FOS-8	SUN SPARC 20/71	18 A-11	FOS-EOC-8 FOT User Station (C,S)
19	FOS-9	SUN SPARC 20/71	19 A-12	FOS-EOC-9 FOT User Station (C,S)
20	FOS-10	SUN SPARC 20/71	20 A-13	FOS-EOC-10 FOT User Station (C,S)
21	FOS-1	Laser Printer	21 A-4	FOS-EOC-1 Printer
22	FOS-3	Color Printer	22 A-6	FOS-EOC-3 Printer
23	FOS-5	SUN SPARC 20/71	23 A-8	FOS-EOC-5 FOT User Workstation (C)

Figure 4-2. PCA Floor Plans

4.4 FCA

This audit evaluated functional characteristics of the ECS system, as tested during acceptance testing, to assure these met design requirements specified in contract. Contractual design requirements had been place in RbR (Requirements by Release) database, which was used to maintain the status of each requirement (i.e., Pass, Partial, Fail, or Unverified) throughout the acceptance test period.

4.4.1 Acceptance Test Results.

All acceptance tests were available. Further discussion of this testing is beyond the scope of this document.

4.4.2 RbR Test Status.

All tests were mapped to FOS Release A requirements; however, this analysis is beyond the scope of this document.

5. Audit Results

5.1 PCA

Date Conducted: November 14, 1996

A "kickoff" meeting was held for the PCA on November 6, 1996 at which the composition of the audit team was finalized and team members were asked to specify their requirements for the audit. The audit team was composed of representatives from the ESDIS Project Office, GSFC Flight Assurance Directorate and from the ECS FOS Development, CM, M&O, and QO organizations.

The audit was held on November 14, 1996 and resulted in 38 Non-Conformance reports being written. The complete listing of all NCRs is found in paragraph 5.1.1 through 5.1.3. While many of these were easily correctable, several NCRs, particularly that on VDD custom software listing compared to the console directory, were initially seen as problems. This NCR was written when audit team members compared file dates and found that many were 1) after VDD dates or 2) before current date regarding the custom software. This finding was considered significant.

As a result the audit team required that both the VDD and White Paper be "redlined" and that the PCA be resumed upon completion of that activity.

5.1.1 VDD NCRs

FP Nr	Doc	Discrepancy	Remarks
06, 14	VDD Table 4-1.00 & 4-2.00	Discrepancy between VDD and FOS COTS Hardware for Release A White Paper. Item FOS-EOC-6 and FOS-EOC-13 are listed in Table A-1, but not included in Tables 4-1 or 4-2	Corrected.
02	VDD Table 4-1.01	Incorrect information in Table 4-1. Not all the COTS software listed in Table 4-1, COTS Software Inventory List, is included in the documented hardware: - DCE's not loaded - Driver for EISA not loaded - ClearCase Client 2.1 not loaded - Netscape Browser not loaded - C++Softbench loaded, but not useable. The following message appeared: "Attempt to request license failed, trying again".	Corrected.

04	VDD Table 4-1.01	Incorrect information in Table 4-1. (Although Table 4-1 did not include this, it (Multicast Server) was compared against the information for MSS-EOC-3: - DCE for Solaris 2.4 not installed - ClearCase Server and Client not installed - Tivoli Client not installed - Netscape browser not installed - DDTS not installed - XRPII not installed	Corrected.
01, 02, 23, 18, 19, & 20	VDD Table 4-1.01	COTS Software Inventory List. Version of X/Motif needs to be added.	Corrected.
01, 02, 23, 18, 19, & 20	VDD Table 4-1.01	Table 4-1 missing version number for X/Motif. Version of X/Motif needs to be added everywhere if it is listed in the table.	Same as ECSed04606
06	VDD Table 4-1.02	Discrepancy between VDD and FOS COTS Hardware for Release A White Paper. No COTS software listed for FOS-EOC-12 Time Gateway	Corrected.
13, 14, 18, 19, 20, 23	VDD Table 4-1.03	Could not verify Sybase version number in Table 4-1. Unable to validate that the Sybase version number listed in Table 4-1 (in several places) was correct.	Corrected.
04	VDD Table 4-1.04 & 4-2.00	VDD missing COTS/Shareware information for MSS-EOC-4. Missing COTS sfwe and shareware inventory for MSS-EOC-4	Shown as "CSS" instead of "MSS". Corrected.
01	VDD Table 4-1.07	Observation. More software was resident on physical hardware than was listed in the VDD	Corrected.
13	VDD Table 4-1.07	COTS Software Library List for FOS-EOC-7 Data Server: Version numbers were missing from several COTS software items (e.g., Digital OS which was version 3.2 D-2 on the associated hardware)	Corrected.
13	VDD Table 4-1.07	COTS Software Library List for FOS-EOC-7 Data Server: DEC C++ for U/A was listed as version 1.3.B but the hardware was version 5.1 installed on it	Corrected.

13	VDD Table 4-1.07	COTS Software Library List for FOS-EOC-7 Data Server: Software listed in VDD was not installed on associated hardware (specifically RogueWave libraries, IMSL/C, and DCE Client were not installed)	Corrected.
19	VDD Table 4-1.09	Remove component description in Table 4-1. Remove the component item "DCE for Solaris 2.4" from the information for FOS-EOC-9 per Hughes representative. Should also be removed for other FOT user stations?	Corrected.
01, 17	VDD Table 4-1.14	Confusing information for Solaris Operating System Version Number. Information in Table 4-1 shows SOLARIS Operating System (v.2.4), but software shows SUN OS 5.4.	Corrected.
19	VDD Table 4-1.14	Incorrect information in Table 4-1. Not all the COTS software listed in Table 4-1, COTS Software Inventory List, is included in the documented hardware: - remove "DCE for Solaris 2.4 from list - remove Rtie and RTServer from the list since they are not installed and not needed in Release B	Corrected.
01	VDD Table 4-1.15	Table 4-1 information incorrect for MSS-EOC-3. Contains incorrect info for MSS-EOC-3. It shows SUN COTS when it should be HP.	Corrected.
02,04, 14,19, 20,23	VDD Table 4-2.01	Discrepancy between VDD and FOS COTS Hardware for Release A White Paper. Table 4-2 does not have any shareware listed for ISS-EOC-1, FOS-EOC-5, FOS-EOC-6, FOS-EOC-13, MSS-EOC-4 or FOS-EOC-12	Corrected.
13	VDD Table 4-2.03	Software Inventory for FOS-EOC-7 Data Server. None of the shareware listed in Table 4-2 (Kerberos Npassword, TCP Wrappers and Tripwire) was found installed on the associated hardware – FOS-EOC Data Server	Corrected.
14	VDD Tar list (4.2.1)	Discrepancy between VDD Custom Software List and fose8oe list. Comparison of VDD custom software listing and version fose8oe and numerous discrepancies were found; specifically file dates were 1)after VDD dates or 2) before current date	Corrected.

5.1.2 White Paper NCRs

FP Nr	Doc	Discrepancy	Remarks
06	WP Table A-1	Discrepancy between VDD and FOS COTS Hardware for Release A White Paper. Item FOS-EOC-12 is listed in Table A-1 as a console but is shown in Table 4-1 in two places as a console manager and as a time gateway	Corrected.
04	WP Table A-1 VDD Table 4-1.00	Discrepancy between VDD and FOS COTS Hardware for Release A White Paper. Item CSS-EOC-4 is listed in Table 4-1 but not shown in Table A-1	Should be MSS. Corrected.
18,19	WP Table A-1 VDD Table 4-1.11	Discrepancy between VDD and FOS COTS Hardware for Release A White Paper. Table A-1 describes these items as "consoles" but Tables 4-1 and 4-2 refer to them as "Console Managers"	Corrected.
13	WP Table A-10	Incorrect information in Table A-10. (NASA/GSFC Bar Code should be 00001592 (not 00001588)).	Corrected.
18	WP Table A-11	Incorrect/missing information in Table A-11. Wrong part numbers listed for a component and missing NASA/GSFC bar codes numbers for 20" color monitor	Corrected.
18,19, 20	WP Table A-11 to 13	Missing NASA/GSFC Bar Code information for some color monitors. Missing NASA/GSFC bar codes numbers for monitor shown in tables A-11 through A-13.	Corrected.
19	WP Table A-12	Incorrect Information in Table A-12. Incorrect NASA/GSFC bar code number for the 75 mHz SPARCStation SX	Corrected.
15	WP Table A-14	Missing information in Table A-14. Table A-14 does not include the NASA/GSFC Bar Code for the component "Terminal Server"	Corrected.
16	WP Table A-15	Table A-15 is missing information. Table is missing the NASA/GSFC Bar Code number for DAT Tape Drive (external), keyboard, mouse, and terminal server.	Corrected.

19	WP Table A-19	FOS-EOC-9 FOT User Station. NASA/GSFC bar code for 20" monitor was incorrect.	Corrected.
19	WP Table A-19	FOS-EOC-9 FOT User Station. NASA/GSFC bar code for SPARCStation is incorrect.	Corrected.
02	WP Table A-2	Incorrect part number in Table A-2. (3-button mouse part number should be A2839B (not 46060B)).	Corrected.
06	WP Table A-3	ISS-EOC-1 Internetwork Equipment. Table A-3 should show that the Time Gateway equipment is a part of the equipment rack. Diagram is not clear.	Corrected.
06	WP Table A-3	ISS-EOC-1 Internetwork Equipment. It needs to be clearly stated which of the strings are prime and which backup	Corrected.
06	WP Table A-3	FOS-EOC-12 Time Gateways. Datum Synchronized Time Codes for prime and backup have no NASA/GSFC bar codes.	Corrected.
06	WP Table A-3	Time Gateway. NASA/GSFC bar codes need to be added.	Corrected.
06	WP Table A-3	Table A-3. ISS-EOC-1 Internetwork Equipment. Could not find: FDDI Workgroup Processor. Clearly state in documentation.	Corrected.
06	WP Table A-3	Table A-3. ISS-EOC-1 Internetwork Equipment. Could not find: FDDI board. Clearly state in documentation	Corrected.
06	WP Table A-3	Table A-3. ISS-EOC-1 Internetwork Equipment. Could not find: Synoptics Concentrator maintenance. Clearly state in documentation	Corrected.
06	WP Table A-3	Observation. There was no rear support for rack mounted equipment in ISS rack	Corrected.
06	WP Table A-3	Incorrect Information in Table A-3. Wrong serial number for Synoptics FDDI Concentrator (#1965732 should be 1965773)	Corrected.

06	WP Table A-3	Missing Information in Table A-3. Synoptics FDDI Concentrator and Ethernet switches in the Support LAN rack are not listed in Table A-3	Corrected.
06	WP Table A-3	Unable to locate FDDI boards. Unable to locate FDDI boards listed in Table A-3	Corrected.
06	WP Table A-3	ISS-EOC-1 Internetwork Equipment. Backup internetwork equipment not listed. This is the second blue cabinet next to Box 6 in the ER diagram.	Same as ECSed04601. Corrected.
13	WP Table A-5	File Server in EOC ER. Fileserver and its components should be shown properly on EOC ER diagram and its White Paper description. The file server should be next to data server and real time server.	Corrected.
14	WP Table A-5	RAID File Server. Description states mouse. No mouse on system.	Corrected.
13,14	WP Table A-5	Discrepancy between VDD and FOS COTS Hardware for Release A White Paper. Item FOS-EOC-2 is listed in Table A-1 as the RAID File Server, but is shown in Table 4-1, in two places, as a RAID File Server and Real Time Server.	Corrected.
17,18, 19,20, 23	WP Table A-8, 11-13 & 18	Workstations (general) FOS and MSS. Each W/S should have correct part nr, serial nr and NASA/GSFC bar code as stated in White Paper.	Corrected.
14	WP Table A-9	FOS-EOC-6 RT Server has no separate listing of FDDI cable connectors.	Corrected.
13	WP Table A-9 & A-10	FOS-EOC-6&7 Discrepancies. FOS-EOC-7 has cable listed as part nr BN23G-02 but found to be labeled -07	Corrected.
13	WP Table A-9 & A-10	FOS-EOC-6&7 Discrepancies. FOS-EOC-7 had no FDDI cable or connectors associated even though there were FDDI cables physically connected to equipment	Corrected.

14	WP Table A-9 & A-10	Data Server and Real Time Server. It should be mentioned that Data Server and RT Server are in same rack.	Corrected.
14	WP Table A-9 & A-10	FOS-EOC-6&7 Discrepancies. FOS-EOC-6 RT Server Cable listed in the table as Part Nr BN23G-02 is physically labeled as 03. This is inconsistent with table.	Corrected.
14	WP Table A-9 & A-10	FOS-EOC-6&7 Discrepancies. FOS-EOC-6 RT Server cabinet has two power supplies not identified as part of hardware configuration	Corrected.
14	WP Table A-9 & A-10	FOS-EOC-6&7 Discrepancies. FOS-EOC-6 RT Server FDDI cables have two different connectors, yet all cables have the same number.	Corrected.

5.1.3 Other NCRs and Suggestions

FP Nr	Doc	Discrepancy	Remarks
00		General. If a piece of equipment is part of a main system component, it should be shown that way. You could indent the components of the main system to show that it is part of a main system equipment. (Example provided showing that equipment should be shown as being part of its main system component by indenting components to show it is part of main system.)	Corrected.
00		General (hardware). Hardware labeling on cables needs to be clearly defined in documentation	Corrected.
13	FP	Storage Cabinet. No storage cabinet in EOC ER. This cabinet is next to Block 13.	Not part of Release A PBL
00		Observation. There was no uniform identification labels for jack and connectors. Internetworking cables were identified, but individual connectors and jacks were not.	Corrected.
00		Observation. There is a need to have physical layout information incorporated into documentation used and controlled by system users. There is also a need to have interconnection diagrams/drawings for system inter- and intra-connection of cables.	Noted

5.2 PCA

Date Conducted: (November 22, 1996)

After an intensive period of revision, FOS and CMO team members informed the audit team that all NCRs had been addressed and requested the PCA be reopened. This occurred on November 22, 1996. "Redlined" documents were presented to the audit team and discussed with the audit team. Following that a detailed inspection of all items was conducted. As a result of this activity all NCRs were closed.

This review concluded with signing of the PCA certificate by all audit team members. A composite certificate is included below.

PCA Certification

Certificate

Physical Configuration Audit was conducted on Release A of the Flight Operations Segment on November 14 and 22, 1996 at the EOC.

Audit examined the "as built" FOS configuration to assure it conforms to Release A design documentation as contained in:

- Version Description Document: 814-RD-007-002
- Technical White Paper: 320-WP-001-002

As result of participating in this audit as an Audit Team Member I certify that the audited configuration

- ☐ Conforms to the Product Baseline
- ☒ Conforms to the Product Baseline upon resolution of the following specified problems:
  Delivery of Product Baseline Documentation
- ☐ Does Not conform to Product Baseline.

PCA Team Members *11/26/96*
(Name) (Organization) (Date)

Figure 5-1. PCA Certificate

5.3 FCA

A “kickoff” meeting was held for the FCA on November 21, 1996 at which team members specified their requirements for the audit. This consisted of requirements baseline reports on Requirements Status, RbR Requirements, and Mapping to Test Cases, NCRs, and Level 4 requirements being requested for the FCA. The team also wanted to review complete Acceptance Test Results, Test Procedures, and Test Status information. Also requested were NCR reports by Severity, by Test by Severity, and by Subsystem by Severity.

The FCA was held on November 25, 1996. A large portion of the morning session of the FCA was devoted to the FOS Deputy Manager updating all team members on test results by subsystem. This briefing proved very valuable and set the approach for later documentation review. The documentation review took place in the afternoon and resulted in 6 action items being assigned. These are listed below:

Nr	Doc	Discrepancy	Remarks
1	NCR	The current NCR priority of 3 for NCR # ECSed 04743 will be reviewed for update to a priority 2 NCR. This NCR is mapped to a FOS requirement.	Closed at RRR
2	NCR	The problem text in NCR # ECSed 04665 will be clarified to reflect the intermittent nature of this problem with telemetry archive on the Q channel.	Closed at RRR
3	NCR	The text of NCR # ECSed 04749 will be updated to reference requirement F-ANA-08040.	Closed at RRR
4	Test	The test log for ANA-2000A will be updated to reflect NCR # ECSed 04413, which was written against a requirement that is mapped to this test case.	Closed at RRR
5	Home page	An investigation will be made to update the NCR homepage to provide a grid that displays OPEN (NCR statuses of "N", "A", "O", "R", "T", "V") and CLOSED (status of "C").	In process
6	RTM	Update RTM to map requirement F-FUI-09120 to test case ANA-2000A.	Awaiting RTM update cycle

This review concluded with signing of the FCA certificate by all audit team members. A composite certificate is included below.

FCA Certification

Certificate

Functional Configuration Audit was conducted on Release A of the Flight Operations Segment on November 25, 1996.

Audit examined all Acceptance Test documentation to assure that all requirements for FOS Release A have been verified.

As result of participating in this audit as an Audit Team Member I certify that FOS Rel A FCA has been:

- ☐ Successfully completed.
- ☒ Successfully completed upon resolution of the following specified problems:
  Action Items 1-6
- ☐ Not successfully completed.

FCA Team Members *11/25/96*
(Name) (Organization) (Date)

Figure 5-2. FCA Certificate

5.4 Other Observations.

5.4.1 Hardware

There were four items of SDPS/CSMS that were intended to interface with FOS. While included in the audit, these items were non-functional and not used by FOS Release A.

There were numerous questions raised by the Internetworking Equipment; specifically, which items of this equipment were part of the Release and which were not. For completeness all of this all internetworking equipment was brought into this Release and this information incorporated into the “redline”.

Time Gateways (2 each) were shown as a separate appendix although they were really part of Internetworking Equipment. The two appendices were combined in the "redline".

5.4.2 Software

FOS Custom Software Tar File Listing (of files generated by the build and installation processes) was the subject of considerable controversy in the PCA when it was realized that the executable files (in the VDD) did not match those on the file servers on which custom code was installed. Explanations were provided and it was realized that the software was under FOS CM control, not project CM. While accepted for this audit these procedures are contrary to ECS Developmental CM Plan and test procedures.

COTS Software Inventory and Shareware were replete with discrepancies. While corrected in the "redline" the reason for these discrepancies was that the origin of these tables had been a spreadsheet generated from VCATS Property data that reflected software purchases, not software installed.

Several appendices of the VDD were not reviewed in any detail. This included Build Instructions, Installation Procedures, Special Operating Procedures, and User Feedback Procedures.

5.5 Material Inspection and Receiving Report

Audit team members had been advised that a Material Inspection and Receiving Report (DD Form 250) was not required. When it was learned that such a report was required all steps were taken to obtain and complete the report. This was done and the form submitted to the Government on the required date.

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6. Lessons Learned

6.1 Requirements:

Existing project documentation establishes the requirement for conducting configuration audits, and establishing the PBL. Missing is any document clearly stating that the focus on these audits is to deliver successive Releases to the Government. Also missing is an integrated plan that requires establishing of an audit team, work toward an integrated schedule, definition of specific deliverables, and conduct of the audits. The fact that the audit was successful in absence of such a plan is testimony to the audit team members who worked effectively together. In the future such a plan should be developed, staffed, agreed to, and implemented.

6.2 Conduct of the Audits

The audits took place within a three week period from an initial kickoff meeting (November 6, 1996) to the audit summary at the RRR (November 27, 1996). This was a very compressed schedule considering the amount of documentation that had to be reviewed within this period. Future audits should assure that there is sufficient time available for the audit team to assimilate fully the review documentation.

Documentation prepared for the PCA, while recognized as the minimum needed, was marginally adequate for this audit. Physical audits need both a comprehensive as well as a site-specific system definition[9], an up-to-date physical layout drawing of the site audited, network configuration drawings, and an inventory report that can be used to assure completeness of the release being audited[10].

Documentation made available for the FCA was exceptionally well set up, documented, and established. All the "tools" needed to audit the functionality of the release were brought together; as a result the FCA was the highlight of the overall audit process.

6.3 Results

6.3.1 PCA

"Kickoff" meeting on November 6, 1996 was an effective way of bringing together all participants and assuring that the audit was ready to proceed.

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9 These were not required for FOS Release A.

10 Neither the layout drawing, the network configuration drawings, nor the inventory report are required by CDRL.

An analysis of the thirty-eight NCRs generated during the audit reveals that the majority of reports documented minor, easy to correct deficiencies. For software these included incorrect version numbers, incomplete installation of COTS software, and similar items. For hardware they included incorrect descriptions, incomplete inventory listing, and missing labels on cabling. In determining the "root cause" of these discrepancies it was found that the hardware and network equipment had bee installed by M&O in the Summer of 1996 and "handed over" to FOS personnel at that time. Unfortunately, in the intervening period between "handover" and audits, changes to the installed configuration had not been recorded. This "underlap" should be investigated and proper configuration status accounting procedures implemented as rapidly as possible.

When it became apparent that a second PCA was required the audit team devoted eight days of intensive effort to develop "redlined" documentation that reflected corrections that were proposed to the PBL. This activity generated a document that reflected how the Government expected the DD-250 inventory to appear. This documentation, which was to be delivered to the Government on RRR + 30 days, should be used as a model for future audits.

Problems encountered during the conduct of the PCA made it clear that a more intensive pre-audit activity should have been undertaken to assure that the inventory was complete, properly documented, and easier to audit.

As indicated in paragraph 5.4.2. software turnover was not conducted in accordance with project documentation. While this was caused by the relatively short period of time available to conduct the audits and the intermediate nature of FOS Release A, this practice should not be allowed to continue. The Developmental Configuration Management Plan (102-CD-001-004), and the Software Development Handbook (Project Instruction CM-1-025) document how turnover is to be accomplished. These documents should be followed.

6.3.2 FCA

Once again the "kickoff" meeting proved an effective way to initiate this review. While this review required the development of a significant amount of material by the contractor, its benefits were seen during the audit when all needed material was on hand and easily accessible to the Government.

Similarly effective was the initiative by the FOS Deputy Manager to present a detailed analysis of all test results to the audit team at the start of the FCA. This interactive presentation answered most of the questions of the audit team and guided audit team members in their analysis of the documentation provided.

6.4 Overall

Configuration audits for FOS Release A were conducted successfully at the EOC and at the Landover site by a dedicated team of contractor and Government personnel, which certified[11] their results. The configuration was conveyed to the Government by Material Inspection and Receiving Report on the date specified in the contract, December 1, 1996.

[11] All conditions to acceptance listed on audit certificates have been met (i.e., closure of FCA action items) or are being met by documentation on the same delivery schedule as this report (i.e., delivery of PBL documentation in accordance with "redlines").

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Abbreviation and Acronyms

CCB	Change Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CDRD	Contract Data Requirements Document
CDRL	Contract Data Requirements List
CI	Configuration Item
CM	Configuration Management
CMO	Configuration Management Office
COTS	Commercial Off-The-Shelf
CSCI	Computer Software Configuration Item
CSR	Consent to Ship Review
CSS	Communications Sub-System
DAAC	Distributed Active Archive Center
DD	Department of Defense
DID	Data Item Description
DMO	Data Management Organization
ECS	EOSDIS Core System
EDF	ECS Development Facility
EDHS	ECS Data Handling System
EOC	ECS Operations Center
EOSDIS	Earth Observing System Data and Information System
ER	Equipment Room
FCA	Functional Configuration Audit
FOS	Flight Operations Segment (ECS)
GSFC	Goddard Space Flight Center
HITC	Hughes Information Technology Company

HWCI	HardWare Configuration Item
IRD	Interface Requirements Document
ISS	Internetworking Sub-System
L4	Level 4
M&O	Maintenance and Operations
MIL STD	Military Standard
MIRR	Material Inspection and Receiving Report
MSS	Management Sub-System
NASA	National Aeronautics and Space Administration
NCR	Non-Conformance Report
NLT	Not Later Than
PBL	Product BaseLine
PCA	Physical Configuration Audit
PI	Project Instruction
QA	Quality Assurance
QO	Quality Office
RAID	Redundant Array of Inexpensive Disks
RBRs	Requirements by Release
Rel A	Release A
RRR	Release Readiness Review
RTM	Requirements and Traceability Management
SDPS	Science Data Processing Segment (ECS)
SOW	Statement Of Work
VCATS	Vendor Cost And Tracking System
VDD	Version Description Document
WBS	Work Breakdown Structure
WP	White Paper